Elect. Stds.

BERTAN High Voltage

INSTRUCTION MANUAL

c. 1

INSTALLATION AND OPERATING MANUAL BERTAN SERIES 225 / 226

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SECTION I INTRODUCTION/SPECIFICATIONS

1.0 SCOPE OF MANUAL

This manual is provided to assist the user in the installation and operation of Bertan Series 225/226, IEEE-488 (GPIB) programmable high voltage power supplies. Statements apply to all models unless reference is made to specific models. **For the safety of personnel and equipment:** It is essential that this manual be thoroughly read prior to installation and the application of power.

1.1 PURPOSE OF EQUIPMENT

The Series 225/226 is a family of precisely regulated, GPIB programmable high voltage power supplies. They offer exceptional performance in such critical applications as nuclear and electro-optical instrumentation, medical imaging and capillary zone electrophoresis and precision CRT displays.

1.2 DESCRIPTION

The units are fully enclosed and are mountable in a standard 19" rack. A wide range of stable outputs up to 50kV are available. Output voltage is set either by front panel controls (series 225 only) or the IEEE-488 interface (series 225 and 226). Intelligent programming, monitoring and automatic overload protection of the power supply are provided. Remote analog voltage or resistance programming and remote analog monitoring are provided on all models.

Output polarity reversal is achieved by turning a polarity switch on the rear panel of 0.5kV, 1kV, 3kV and 5kV units. The 10kV and higher output models have an internal polarity reversing assembly. **Note: In either case, polarity reversal MUST only be done when the high voltage is OFF.**

The Series 225/226 units contain a DC power supply to convert the AC line power to low voltage DC and a DC/DC converter which generates the high DC voltage. The analog circuits and microprocessor logic circuits are placed on plug-in circuit boards. The high voltage assembly is encapsulated in silicone rubber for reliable, arc-free and stable operation.

1.3 ELECTRICAL SPECIFICATIONS

Input Power:	115/230Vac ±10%, 50 - 60Hz, 1.0A/0.5A
Output Power:	See TABLE 1.1 for Output Voltage & Output Current ratings of each model in the Series 225/226.
Ripple:	See TABLE 1.1 for maximum peak-to-peak ripple.
Accuracy:	±(0.1% of setting + 0.05% of maximum kV)
Voltage Resolution:	Values in TABLE 1.1 apply to Output Setting, Limit Setting and Monitor Output.
Current Resolution:	Values in TABLE 1.1 apply to Limit Setting and Monitor Output.
Line Regulation:	±0.001% for a ±10% input line change.
Load Regulation:	±0.005% for a NL to FL, FL to NL change.

TABLE 1.1

MODEL	OUTPUT VOLTAGE	OUTPUT CURRENT	OUTPUT RIPPLE	RESOLUTION VOLTAGE	RESOLUTION CURRENT
225-P5R/226-P5R	0 to 500V	0 to 60mA	10mV	10mV	1 A
225-01R/226-01R	0 to 1kV	0 to 30mA	10mV	100mV	1μA
225-03R/226-03R	0 to 3kV	0 to 10mA	30mV	100mV	1μA
225-05R/226-05R	0 to 5kV	0 to 5.0mA	50mV	100mV	100nA
225-10R/226-10R	0 to 10kV	0 to 2.5mA	100mV	1V	100nA
225-20R/226-20R	0 to 20kV	0 to 1.0mA	300mV	1V	100nA
225-30R/226-30R	0 to 30kV	0 to 0.5mA	400mV	1V	10nA
225-50R/226-50R	0 to 50kV	0 to 0.3mA	2.0V	1V	10nA

Stability: 0.01%/hr. ; 0.02%/8hrs.

Temp. Coeff: 50ppm per ^{0}C, over the range 0 to 50^{0}C.

Protection: Short circuit and arc protected. Programmable voltage and current limits of 0% to 101% of maximum ratings.

Meter: 5 digit LED panel meter with polarity indicator.

Indicators: OUTPUT INDICATORS: Power ON, High Voltage ON, Volts, Milliamps, Overload and Tripped.
IEEE-488 OPERATION INDICATORS:
Remote, Listen, Talk and Service Request.

Digital Programming: Output Voltage, Output Voltage Limit, Output Current Limit, Overload Response Modes and Service Request Modes are programmable via the IEEE-488 interface.

Digital Monitoring: Output Voltage, Output Current, Mode Settings, Model Number and Software Revision are all parameters which can be monitored through the IEEE-488 interface.

Analog Programming: 0 to +5Vdc input via the rear panel analog PROGRAMMING/MONITOR connector for 0 to maximum voltage output. Analog programming can also be accomplished using a 5kΩ to 20kΩ, low temperature coefficient, wirewound or cermet type potentiometer.

Analog Monitoring: Remote current and voltage monitoring signals 0 to +5Vdc (via 10kΩ) are available at the rear panel analog PROGRAMMING/MONITOR connector. (See section 5.2 and Figure 5.1 for pin designations).

Logic: $\overline{\text{TRIP}}$ control input.
High voltage polarity output indicator (NEG/POS).

Polarity: Selectable by user. High voltage **MUST BE OFF** and the output **COMPLETELY DISCHARGED** before switching.

Input Connector: IEC socket with detachable line cord. Line cord is provided.

Analog Connector: Amp 207456-4. The required mating connector is provided with each unit. The REMOTE ANALOG connector pin designations can be found in Figure 5.1

Digital Connector: IEEE-488. (A mating IEEE-488 cable is not provided).

HV Connector: The high voltage panel connector and its respective mating connector for all models in the 225/226 Series is listed in Table 1.2 below. Each unit is supplied with the appropriate mating high voltage connector.

TABLE 1.2

MODEL	HV OUTPUT CONNECTOR	MATING HV CONNECTOR
225-P5R / 226-P5R	JDK	PDB
225-01R / 226-01R	JDK	PDB
225-03R / 226-03R	JDK	PDB
225-05R / 226-05R	JDK	PDB
225-10R / 226-10R	JJA	PJA
225-20R / 226-20R	JJA	PJA
225-30R / 226-30R	JJA	PJA
225-50R / 226-50R	JJB	PJB

Size: 19" wide x 3-1/2" high x 9-5/8" deep
(483 x 89 x 244mm), 0.5kV thru 20kV models

19" wide x 5-1/4" high x 16" deep
(483 x 133 x 406mm), 30kV and 50kV models

Weight: 20 lbs (9.1 kg) 0.5kV thru 20kV models
35 lbs (15.9 kg) 30kV and 50kV models

SECTION II GENERAL DESCRIPTION

CAUTION- THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

2.1 INSTALLATION

The Series 225/226 high voltage power supplies mount in a standard 19" rack. All statements referring to front panel control or display apply only to series 225 units. Series 226 units are only operable under remote analog control or IEEE-488 (GPIB) control.

2.2 INPUT POWER

The input AC line voltage required is 115/230Vac ±10%, 50 - 400Hz, single phase. The LINE VOLTAGE selector switch on the rear panel **MUST BE SET** for either 115Vac or 230Vac operation **BEFORE** application of input power.

2.3 POWER-ON/SELF TEST

When AC power is first applied, the unit will illuminate all of its LED segements in the front panel display for user inspection. Then it will display its configuration as shown in the EXAMPLE 2.1 below.

DISPLAY EXAMPLE 2.1

"+225.P5" 225-P5R set to positive output polarity.
"-225.30" 225-30R set to negative output polarity.

While the above is being displayed, the unit performs a series of power-on self tests. If an internal self test detects a failure, that failure will be displayed as one of the following error messages:

E r r 1 µP RAM error
E r r 2 µP ROM error
E r r 3 µP A/D error

The above messages are also available via the IEEE-488 interface. (See Section 3.2.2). If no error is found, the unit will commence displaying voltage readings.

2.4 VOLTAGE CONTROL

A Series 225/226 power supply has three modes of controlling the high voltage output available to the user. Set the PROGRAM CONTROL switch (S101) on the rear panel to LOCAL/IEEE-488 for front panel control or for remote IEEE-488 control. For remote analog control, set the switch to the REMOTE ANALOG position. The high voltage output can then be remotely programmed from either an external voltage source or by using an external potentiometer. When S101 is in the REMOTE ANALOG position, the front panel controls will have no effect on the output voltage setting.

At all times, regardless of the position of the rear panel PROGRAM CONTROL switch or of the GPIB status (Local, Remote or Local Lockout), the user may enable or disable the high voltage output by switching the HV ENABLE switch on the front panel. In addition, the voltage and current monitors are always active. Thus, even when the PROGRAM CONTROL switch is set to REMOTE ANALOG control position or the GPIB has brought the unit to remote or to local lockout, the front panel, the GPIB and the remote analog monitors continue to make voltage and current readings available.

2.5 POLARITY REVERSAL

The front panel LED display will indicate which polarity the unit is set for. The display illuminates, even if there is no high voltage output.

CAUTION- LINE INPUT POWER MUST BE TURNED OFF AND THE HIGH VOLTAGE SHOULD BE DISCHARGED FULLY BEFORE PROCEEDING TO REVERSE THE POLARITY.

2.5.1 POLARITY REVERSAL 0.5kV, 1kV AND 5kV OUTPUT MODELS

The screwdriver operated POLARITY SELECTOR switch (S3) is accessible at the rear panel of the unit. Rotate as required for the desired polarity.

2.5.2 POLARITY REVERSAL 10kV to 50kV OUTPUT MODELS

Polarity is reversible by means of an internal polarity module which is easily accessible upon removal of the top cover.

Polarity is reversed by extracting the polarity module, rotating it by 180^0 and then re-inserting it. A safety interlock automatically ensures that the high voltage cannot be turned on unless this module is installed in one position or the other.

A remote polarity indicator is provided at the J107 (PROGRAMMING/MONITOR) connector jack located on the rear panel of the unit, (see section 5.3).

SECTION III GPIB OPERATION

CAUTION- THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

3.1 PROGRAM CONTROL SWITCH

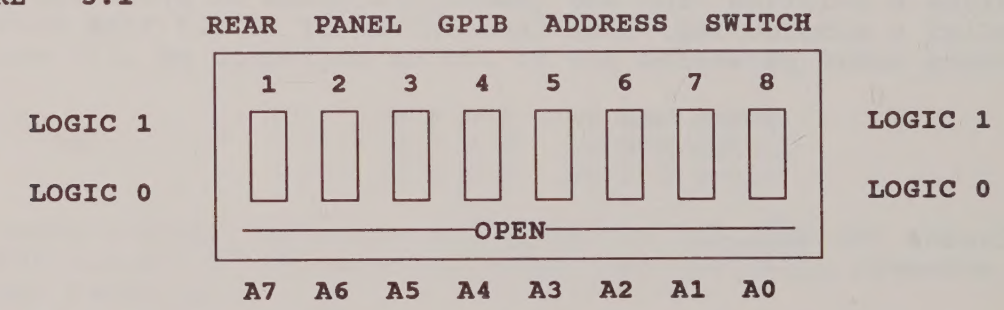
Before a unit of the Series 225/226 may be used in a GPIB system, the user must set the power supply's rear panel PROGRAM CONTROL switch (S101) to the LOCAL/IEEE-488 position.

3.2 GPIB ADDRESS SWITCH

An eight position DIP switch (S9) is located on the rear panel of the unit. Every instrument on a GPIB system must have a unique bus address in the range of 0 to 30, inclusive. A unit's address is set using S9 switch positions A4 through A0. A4 is the most significant address bit and A0 is the least significant bit. Bit A5 of the address switch will enable or disable the power-on Service Request. Bit A6 controls whether the power supply will terminate its output character strings with or without a carriage return and a linefeed. Bit A7 must remain in the logic zero state. Figure 3.1 shows the switch orientation and bit designations.

S9 is read ONLY at power-on. Therefore, when any of the above is to be changed, the unit must first be turned off, the required changes made and then the unit must be turned back on.

FIGURE 3.1



A7 Set to 0

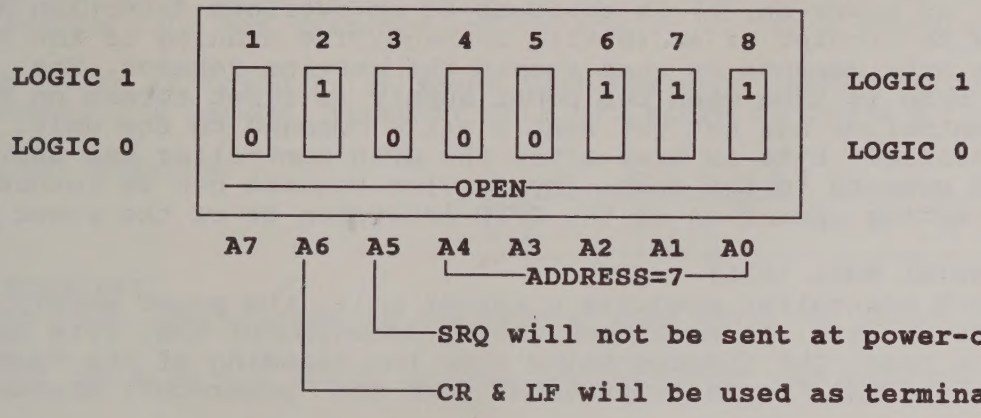
A6 Line Terminators: 1 Carriage Return & Linefeed (CR/LF). (*)
0 No Line Terminators.

A5 Service Request: 1 Service Request sent at power-on.
0 No Service Request is sent at power-on.

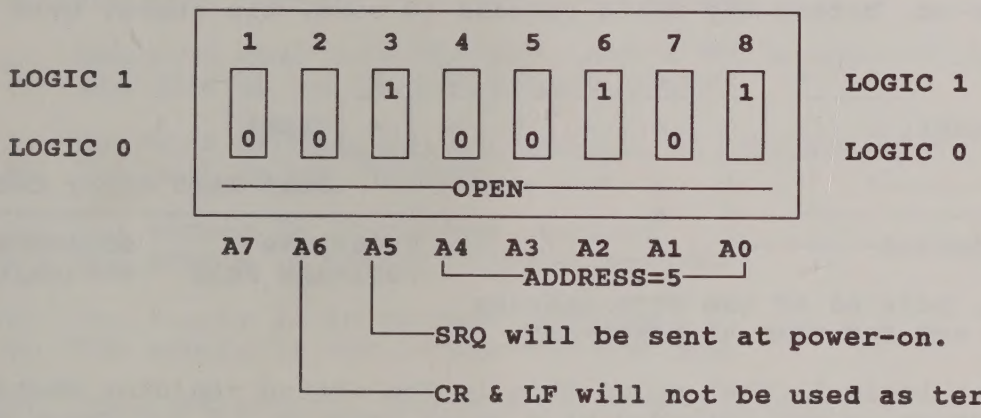
A4 GPIB Address MSB
A3 GPIB Address Bit
A2 GPIB Address Bit
A1 GPIB Address Bit
A0 GPIB Address LSB

(*) Line terminators are, or are not appended to the returned strings described in sections 3.4.8 and 3.4.9 based on the setting of A6.

FACTORY SETTING:


1 2 3 4 5 6 7 8
LOGIC 1
LOGIC 0
1
0 0 0 0 1 1 1
LOGIC 1
LOGIC 0
OPEN
A7 A6 A5 A4 A3 A2 A1 A0
ADDRESS=7
SRQ will not be sent at power-on.
CR & LF will be used as terminators.

ALTERNATIVE EXAMPLE:


1 2 3 4 5 6 7 8
LOGIC 1
LOGIC 0
1
0 0 0 0 1 0 1
LOGIC 1
LOGIC 0
OPEN
A7 A6 A5 A4 A3 A2 A1 A0
ADDRESS=5
SRQ will be sent at power-on.
CR & LF will not be used as terminators.

3.3 GPIB PROTOCOL

The Series 225/226 implements the following GPIB functions:

SH1	Source Handshake	AH1	Acceptor Handshake
T5	Basic Talker & Serial Poll	L4	Basic Listener
RL1	Remote/Local with Lockout	PP0	No parallel poll response
C0	Not a controller		
SR1	Service Request		
DC1	Device Clear	DT1	Device Trigger

Using these GPIB functions, the GPIB controller can send ASCII command strings to control and monitor the high voltage power supply.

3.3.1 DATA TRANSFER FUNCTIONS - SH1, T5, RL1, C0, AH1, L4, PP0

These seven data transfer functions are normally transparent to the user. They permit communication between the GPIB controller and the Series 225/226 high voltage power supplies.

3.3.2 SERVICE REQUEST FUNCTIONS - SR1

SR1 contains two sub-functions: Service Request and Serial Poll. The service request (SRQ) is the mechanism by which a power supply can interrupt the GPIB controller and the serial poll (SPL) is how the GPIB controller can read the status of the power supply.

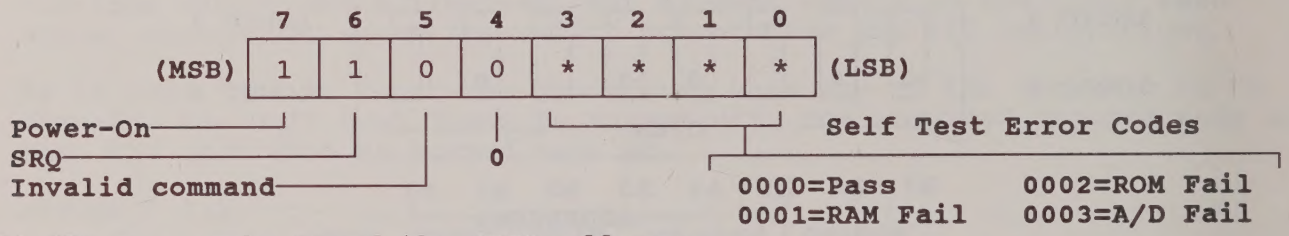
3.3.2.1 SERVICE REQUEST (SRQ)

There are three conditions that can make a power supply issue an SRQ. They are 1) at power-on, 2) in response to an overload detection and 3) in repsonse to receipt of an invalid command. The meaning of the serial poll status byte depends on what caused the service request. The "power-on" byte is true when the power supply is first turned on AND the GPIB controller has not yet sent a valid command to the unit. The "normal operation" byte is true after the GPIB controller has sent its first valid command to the unit. Any service request can be ignored without affecting operation of the GPIB interface or of the power supply.

3.3.2.2 SERIAL POLL (SPL)

When the GPIB controller executes a serial poll, the power supply sends back one status byte. As mentioned above, decoding of that byte depends on when it's read. The figures below show the decoding of the "power-on" status byte and the "normal operation" (not the "power-on") status byte.

FIGURE 3.2
At power-on, before any valid command is sent, the status byte is:

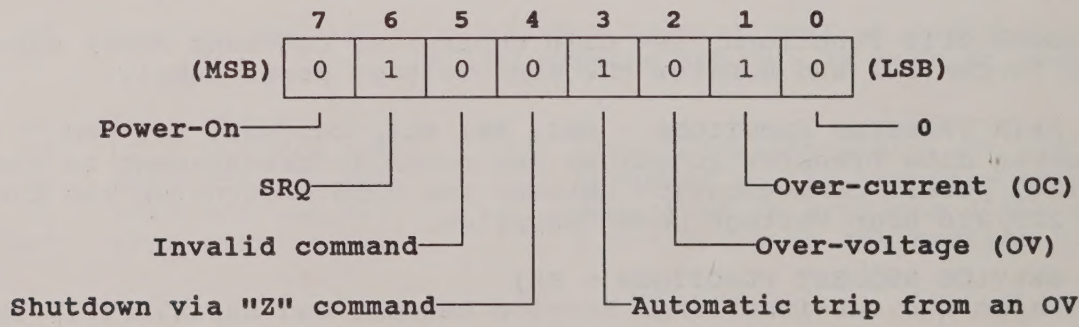


If SRQ = 1, pole A5 of the GPIB address switch was set for "SRQ at power-on".

Bit #7 is at logic 1. That shows this is the status register contents at power on, prior to the issuance of a valid command. If you don't do a serial poll at power on, but simply send any valid command, the status byte obtained in response to a subsequent serial poll will instead be as seen in FIGURE 3.3 below.

Bit #5 and bit#6 function identically as in the normal operation status byte of FIGURE 3.3 below.

FIGURE 3.3
After the first valid command, the status byte looks like this:



Bit #7 is at logic 0. That shows this is the status register contents following the issuance of at least one valid GPIB command since power-on.

If bit #6 is at logic 1, the status byte obtained is in response to the first serial poll taken after issuance of an SRQ. If bit #6 is at logic 0, the status byte was examined before and/or it isn't related to an SRQ.

When bit #5 is at logic 1, it means that the unit cannot recognize the last command you issued. Normally this bit stays at logic 0.

EXAMPLE BIT PATTERN:

7	6	5	4	3	2	1	0
0	1	0	0	1	0	1	0

BIT#: **MEANING:**

7 0: You are looking at the status byte after at least one command.

6 1: This is the first look at status after the issuance of an SRQ.

5 1: The last command you issued was not valid.
0: The last command you issued was valid.

4 1: You have shut down the unit with a "Z" command or DC1.
0: The unit is not in a shut down state.

3 1: The high voltage was tripped off in response to an overload.
0: The unit is not tripped.

2 1: The supply is in voltage overload.
0: The supply is not in voltage overload.

1 1: The supply is in current overload.
0: The supply is not in current overload.

0 0: This bit of this status byte is always logic 0.

3.3.3 DEVICE CLEAR FUNCTION - DC1

The device clear and the selective device clear GPIB functions trip the high voltage output to zero regardless of the actual voltage program. They perform identically to the user command "Z" of section 3.4.4.

3.3.4 DEVICE TRIGGER FUNCTION - DT1

The device trigger function updates any previously programmed parameters. It performs identically to user command `G' of section 3.4.3, but has the additional capability to trigger multiple bus instruments simultaneously.

3.4 USER COMMANDS

The unit recognizes certain received ASCII strings as commands from the GPIB controller which execute all of the unit's functions. They are:

- Programming the Output Voltage ("P")
- Setting Output Voltage and Current Limits ("L")
- Executing (Going ahead with) the Last Issued Commands ("G")
- Shutting Off or Zeroing the High Voltage Output ("Z")
- Restoring the High Voltage Output ("R")
- Selecting the Overload Shutdown Response ("OE" & "OC")
- Selecting the Overload Service Request Response ("SE" & "SC")
- Triggering Meter Readings of the Output ("T")
- Polarity, Model Number & Software Revision Information ("M")

NOTE: All characters in the ASCII command string must be in UPPER CASE ONLY. The interface will not recognize lower case characters.

Program, Limit and Meter command syntax varies depending upon specific model. Table 3.0 shows the Program, Limit and Meter command formats for the Series 225/226 high voltage power supplies.

TABLE 3.0 NUMERIC FORMATS FOR PROGRAM, LIMIT & METER COMMANDS:

MODEL	FORMAT VOLTAGE	FORMAT CURRENT
225/226-P5	0.xxxxx	xx.xxx
225/226-01 225/226-03	x.xxxx x.xxxx	xx.xxx xx.xxx

MODEL	FORMAT VOLTAGE	FORMAT CURRENT
225/226-05 225/226-10	x.xxxx xx.xxx	x.xxxx x.xxxx
225/226-20 225/226-30	xx.xxx xx.xxx	x.xxxx xxx.xx

3.4.1 PROGRAMMING THE HIGH VOLTAGE OUTPUT ("P")

This command allows the user to set the output voltage of the power supply. The syntax is:

"P{numeric string}K"

Where {numeric string} is an ASCII string of the required number of digits and a decimal point. The resolution of the programming and meter values is five digits. Since each model power supply has its own output rating, the programming command for each will have its own format. In general, the program command will be one of those shown below:

P0.xxxxxK	(For zero to 0.5 kV.)
Px.xxxxK	(For zero to 1, 3 or 5 kV.)
Pxx.xxxK	(For zero to 10, 20 or 30 kV.)

The numeric format will depend on the unit being controlled. This numeric format can be packed with zeroes to fully fill five digits. Therefore, if a 1kV power supply is to be programmed to 230 volts, the command could be P0.23K or P0.2300K. Similarly, if a 20kV supply is to be programed to 11,500 volts, the command could be P11.500K or P11.5K.

The actual high voltage output will not change to a newly programmed value after a program command has been issued until the unit also receives a device trigger bus command or the "G" command string (see sections 3.3.4 and 3.4.3).

3.4.2 SETTING THE OUTPUT LIMITS ("L")

Each unit monitors output voltage and current to detect if those parameters exceed the user set thresholds. Each parameter (voltage and current) is monitored at the rate of once per second. The user may set threshold limits which, when exceeded, will invoke the user programmed shutdown and service request responses (see sections 3.4.6 and 3.4.7). The limit commands consist of an "L", a numeric string which represents the threshold value and a final character which distinguishes between the voltage and current limits. A "K" indicates a kilovolt limit and an "M" or "U" indicates a milliamp or microamp limit respectively. The syntax is:

"L{numeric string}K" Kilovolt Limit (All models.)
"L{numeric string}M" Milliamp Limit (All models except 30kV.)
"L{numeric string}U" Microamp Limit (Model 225/226-30R only.)

where {numeric string} is as described Table 3.0. Note in some cases that the numeric formats for the voltage and current are different.

The voltage limit command uses the same numerical format as the programming command, but starts with an "L". Below are some examples:

Lx.xxxxK L0.6523K limits to 652.3V
Lxx.xxxK L29.400K limits to 29.4kV

The output current limit threshold may also be set. When this value is exceeded, the unit will respond as previously programmed by the user. Below are some examples of the current limit command.

Lxx.xxxM L12.000M limits to 12mA
Lx.xxxxM L1.0500M limits to 1.05mA
Lxxx.xxU L473.50U limits to 473.5uA (Model 225/226-30R only.)

An actual limit value will not change to a newly programmed value after a limit command has been issued until the unit also receives a device trigger bus command or the "G" command string (see sections 3.3.4 and 3.4.3).

3.4.3 ENTERING THE CURRENT PROGRAMMING & LIMIT VALUES ("G")

After executing a programming or limit command, these new values will not be used immediately. The user must execute the "G" command which will update the old values with the new ones. Therefore, if the output is presently programmed to 1kV and the user executes a program command such as "P1.5000K", the output will not change to 1.5kV until the "G" command is executed. The syntax is:

"G" the single ASCII character

When timing is not important, the "G" may be appended to the programming or limiting command as shown below.

Pxx.xxxKG
Lx.xxxxMG

3.4.4 SHUTTING THE HIGH VOLTAGE OUTPUT OFF ("Z")

The high voltage output may be turned off by the user without affecting the currently active programming value. The syntax is:

"Z" the single ASCII character

This has the same effect as executing the device clear bus command.

3.4.5 RESTORING THE HIGH VOLTAGE OUTPUT ("R")

The high voltage output may be turned back on to the currently active programming value after having been shut off by a user command "Z" or by a trip due to overload. The syntax is:

"R" the single ASCII character

The high voltage output will return to the value that was last programmed before the shutdown. If the output was turned off by an overload trip, the cause of that overload should be corrected before trying to restore the output voltage or the trip will occur again.

3.4.6 SELECTING THE OVERLOAD TRIP RESPONSE ("OE" & "OC")

When the unit detects that the output has exceeded one of the user programmed limits, it may respond by shutting off the high voltage output, also called tripping. The user may select that the power supply trip itself off for a voltage overload only, for a current overload only, for a voltage or a current overload, or for neither. The syntax is:

"OE{numeric}"
"OC{numeric}"

where {numeric} is the single ASCII character for 0,1 or 2 and:

OE2 Establishes that the unit cannot be programmed to a voltage value above the voltage limit setting.

OE1 Enables the unit to shut down its output upon detection of an output voltage above the voltage limit setting.

OE0 Establishes that the unit will not shut down its output in response to the detection of an output voltage above the voltage limit setting.

OC1 Enables the unit to shut down its output upon detection of an output current above the current limit setting.

OC0 Establishes that the unit will not shut down its output in response to the detection of an output current greater than the current limit setting.

3.4.7 SELECTING THE OVERLOAD SERVICE REQUEST RESPONSE ("SE" & "SC")

Just as the unit can be made to shut off the output in response to an overload, it can also be made to generate a service request to the GPIB controller in response to an overload. The syntax is:

"SE{numeric}"
"SC{numeric}"

where {numeric} is the ASCII byte for 0 or 1 and:

SE1 Enables SRQ in response to an overvoltage detection.

SE0 Disables SRQ in response to an overvoltage detection.

SC1 Enables SRQ in response to an overcurrent detection.

SC0 Disables SRQ in response to an overcurrent detection.

When an SRQ is sent by the unit to the GPIB controller, the user should execute a serial poll of that unit to obtain its status byte. Please note that the overload response choices and the service request choices operate independently of each other.

3.4.8 TRIGGERING METER READINGS OF THE OUTPUT ("T")

Each unit has the capability to perform meter readings of its output voltage and current. The user may trigger a reading of the output voltage, the output current or of both. The syntax is:

"T{numeric}"

where {numeric} is the single ASCII character for 0,1 or 2 and:

T0 Triggers a measurement of the output voltage and current.

T1 Triggers a measurement of the output voltage only.

T2 Triggers a measurement of the output current only.

After receiving one of the "T" commands, the unit will return a character string containing output status (**N**ormal, **T**ripped or **S**hutdown) and voltage and/or current readings. The numerical formats are those used to enter voltage and current values. Below are the "T" commands with some typical strings which are returned to the GPIB controller in response.

		Note: These strings are, or are not, followed
T0	"N Vxx.xxxK Ix.xxxxM"	by Line Terminators CR/LF depending
T1	"S Vx.xxxxK"	upon the chosen setting of switch S9,
T2	"T Ixxx.xxU"	position A6 (see section 3.2).

A leading "N" in the string means the output is on. A leading "S" means that the output was shutdown by the user with a "Z" command or a device clear bus command. A leading "T" means that output was tripped due to an overload detection. Also:

"V" in the string means voltage
"I" in the string means current
"K" in the string means kilovolts
"M" in the string means milliamps
"U" in the string means microamps

3.4.9 STATUS ("M")

After receiving the "M" command, the unit will return a character string with its model number, output polarity setting and software revision. The syntax is: "M" the single ASCII character

In the returned string, "+225 03 re0.8" would denote a positive high voltage output from 0 to +3kV and the use of revision 0.8 software. The use of CR/LF Line Terminators depends on S9, position A6 as above.

3.5 SAMPLE COMPUTER PROGRAMS

Sample computer programs for use with the Series 225/226 can be found in the APPENDIX of this manual. Each sample sends commands to the power supply and shows responses via the computer's CRT.

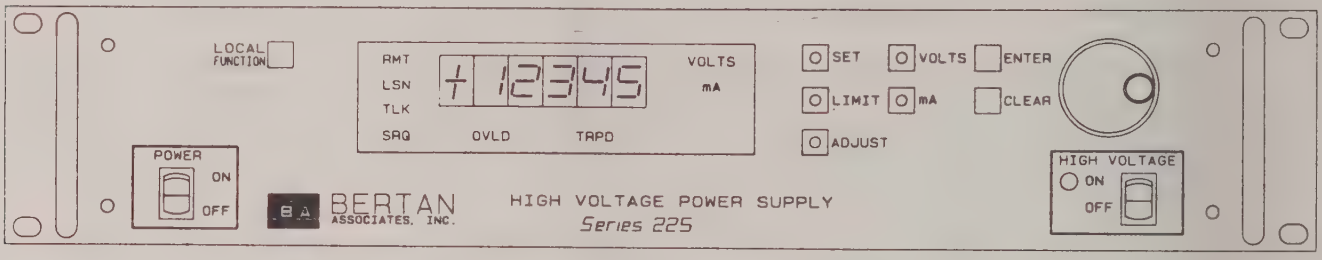
SECTION IV LOCAL OPERATION

CAUTION- THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

4.1 FRONT PANEL CONTROLS

This section applies only to the Series 225 except that the POWER ON/OFF switch, HIGH VOLTAGE ON/OFF switch, and the HIGH VOLTAGE ON LED are also found on the Series 226 front panel. FIGURE 4.1 below is the typical layout of the Series 225 front panel.

FIGURE 4.1



SWITCHES/PUSHBUTTONS/INDICATORS/DIALS:	FUNCTION/PURPOSE:
POWER ON-OFF	Enables and disables AC power.
HIGH VOLTAGE ON-OFF	Enables and disables high voltage. This front panel switch overrides ALL other controls in disabling of the high voltage output.
LOCAL/FUNCTION	Brings the unit from GPIB control to front panel control. It gives the user access to programming features and to model information.
SET	Used to set the output voltage.
LIMIT	Used to program the output voltage limit and output current limit.
ADJUST	Used to adjust the output voltage.
VOLTS	Enables the display to show output voltage readings. It is used when changing the output voltage or the output voltage limit.
mA	Enables the display to show output current readings. It is used when changing the output current limit.
ENTER	Finishes a command entry.
CLEAR	Used to abort a command sequence.

DIGITAL POTENTIOMETER	For entering numerics and mode selections with velocity variable action. Resolution is very high if turned slowly. If turned rapidly, value changes are rapid.
LED DISPLAY	Five digits which show voltage and mA/uA readings and mode settings.
RMT	Remote/Local status of GPIB.
LSN	Listener status of GPIB.
TLK	Talker status of GPIB.
SRQ	Service request status of GPIB.
OVLD	Output overload indicator.
TRPD	Output trip indicator.
VOLTS	Illuminated when the meter is displaying the output voltage.
mA	Illuminated when the meter is displaying the output current.

4.2 PROGRAM CONTROL SWITCH

The front panel controls of the unit are only functional for programming purposes when the unit's rear panel PROGRAM CONTROL switch (S101) is in the LOCAL/IEEE-488 position. However, if the unit receives a voltage programming command while S101 is in the Remote Analog position, the switching of S101 to its LOCAL/IEEE-488 position afterwards will then cause the value of that programming command to take effect.

4.3 LOCAL OPERATION

The local mode of the Series 225 provides all of the control and monitoring functions available with GPIB control. An SRQ may occur with no controller connected to the IEEE-488 connector port (J9). The SRQ front panel LED will illuminate and stay illuminated, but this is of no concern when in the Local mode. An unanswered SRQ will not affect local control in any way and the illuminated LED may be safely ignored.

When the unit is in remote control via the GPIB, the user must press the LOCAL/FUNCTION pushbutton on the front panel to enter the Local mode. If the remote (RMT) LED is not illuminated, then the unit is in the Local mode. Subsequent depressions of the LOCAL/FUNCTION pushbutton will cause the unit to display the information presented on the following page.

If the user chooses, the unit can be programmed from the GPIB to receive programming information only from the GPIB. Then, in response to pressing LOCAL/FUNCTION, the unit will display "LLO" on its front panel display, meaning Local Lockout. In that case, only the GPIB controller will be able to program the high voltage output.

In Local mode, seven sequential pressings of the LOCAL/FUNCTION pushbutton display the following seven items:

▸GPIB address that the user has selected for the unit.

▸Model number and output polarity setting (see DISPLAY EXAMPLE 2.1).

▸Overvoltage trip response setting: OE 0, OE 1 or OE 2.

▸Overcurrent trip response setting: OC 0 or OC 1.

▸Overvoltage service request response setting: SrE 0 or SrE 1.

▸Overcurrent service request response setting: SrC 0 or SrC 1.

▸Software revision number.

For a new OE, OC, SrE or SrC choice, press the LOCAL/FUNCTION push button to obtain the old choice display. Then rotate the DIGITAL POTENTIOMETER for the new choice. Descriptions of the available choices follow below.

An eighth pressing returns the display to voltage or current readings as before the first LOCAL/FUNCTION pushbutton depression.

4.3.1 CHOICES OF OVERVOLTAGE TRIP RESPONSE ("OE")
When a unit detects that output voltage is above its programmed limit, it can respond by shutting off (tripping) the high voltage. The syntax is:

OE2 Establishes that the unit cannot be programmed to a voltage value above the voltage limit setting.

OE1 Enables the unit to shut down its output upon detection of an output voltage above the voltage limit setting.

OE0 Establishes that the unit will not shut down its output in response to the detection of an output voltage above the voltage limit setting.

4.3.2 CHOICES OF OVERCURRENT TRIP RESPONSE ("OC")
When a unit detects that output current is above its programmed limit, it can respond by shutting off (tripping) the high voltage. The syntax is:

OC1 Enables the unit to shut down its output upon detection of an output current above the current limit setting.

OC0 Establishes that the unit will not shut down its output in response to the detection of an output current above the current limit setting.

4.3.3 CHOICES OF OVERVOLTAGE SERVICE REQUEST RESPONSE ("SrE")
At the user's choice, the unit can be made to issue a service request to the GPIB controller in response to a voltage overload. The syntax is:

SrE1 Enables SRQ in response to an overvoltage detection.

SrE0 Disables SRQ in response to an overvoltage indication.

4.3.4 CHOICES OF OVERCURRENT SERVICE REQUEST RESPONSE ("SrC")

At the user's choice, the unit can be made to issue a service request to the GPIB controller in response to a current overload. The syntax is:

SrC1 Enables SRQ in response to an overcurrent detection.

SrC0 Disables SRQ in response to an overcurrent detection.

4.4 FRONT PANEL MESSAGES

DISPLAY	MEANING
E r r	An erroneous command sequence entry has been rejected.
S E	The SET pushbutton has just been depressed.
A d	The ADJUST pushbutton has just been depressed.
L i	The LIMIT pushbutton has just been depressed.
A d r n n	The IEEE-488 GPIB address is the number `n n'.
L L O	Local lockout is on.

4.5 OPERATION EXAMPLES

The following section describes sequences of local control command entry by way of examples. Note: Errors made during sequence entry will result in the error message ("E r r") being displayed on the front panel, but such errors will be rejected and not affect any previously programming.

The following are some common examples of NON-VALID sequences resulting in an `E r r' message display:

COMMAND ENTRY	REASON FOR ERROR MESSAGE
"ADJUST" "mA"	Cannot adjust power supply output current.
"SET" "mA"	Cannot set power supply output current.
"SET" "ENTER"	No controlled parameter, kV or mA, was selected.
"LIMIT" "ENTER"	No controlled parameter was selected.
"ADJUST" "ENTER"	No controlled parameter was selected.
"ENTER"	No controlled parameter or select function was selected.

4.5.1 OUTPUT VOLTAGE SETTING

Push "SET" button: "SET" LED lights and the "SE" message is displayed.

Push "VOLTS" button: "VOLTS" LED lights and the last entered voltage setting value is displayed.

Turn the digital potentiometer knob for the desired output voltage. (The actual high voltage output will NOT change until the following step.)

Push "ENTER" to finish the sequence. The "SET" and "VOLTS" LEDs will go off. If the High Voltage Switch is on, the entered voltage value will be outputted and voltage measurements will be displayed.

4.5.2 OUTPUT VOLTAGE ADJUSTMENT

Push "ADJUST" button: The "ADJUST" LED lights and the "Ad" message is displayed.

Push "VOLTS" button: The "VOLTS" LED lights and the output voltage is displayed.

Turn the digital potentiometer knob for the desired output voltage. **CAUTION:** The ACTUAL high voltage output will start changing immediately in response to this step.

Push "ENTER" to finalize the adjustment and to exit the adjustment mode.

4.5.3 SETTING THE OUTPUT VOLTAGE LIMIT

Push "LIMIT" button: The "LIMIT" LED lights and the "Li" message is displayed.

Push "VOLTS" button: The "VOLTS" LED lights and the present limit voltage is displayed.

Turn the digital potentiometer knob to set the new desired limit.

Push the "ENTER" button to save the displayed entry as the new voltage limit value. The display then returns to presenting the previously measured parameter and the "LIMIT" and "VOLTS" LED's go out.

4.5.4 SETTING THE OUTPUT CURRENT LIMIT

Push "LIMIT" button: The "LIMIT" LED lights and the "Li" message is displayed.

Push "mA" button: The "mA" LED lights and the present limit current is displayed.

Turn the digital potentiometer knob to set a new desired limit. Push the "ENTER" button to save the displayed entry as the new current limit. The display then returns to presenting the previously measured parameter and the "LIMIT" and "mA" LED's go out.

SECTION V REMOTE ANALOG OPERATION

CAUTION- THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

5.1 PROGRAM CONTROL SWITCH

Before a unit can be programmed with a remote analog (0 to +5Vdc) signal, it must be configured by setting its rear panel PROGRAM CONTROL switch (S101) to the REMOTE ANALOG position. Note: All other monitoring and non-programming functions remain active, regardless of the S102 position.

5.2 REMOTE CONTROL

The high voltage output can be remotely programmed from an external voltage source. A 0 to +5Vdc programming voltage applied to Pin 6 of the J107 (PROGRAMMING/MONITOR) connector jack on the rear panel will remotely program the high voltage output from zero to maximum voltage.

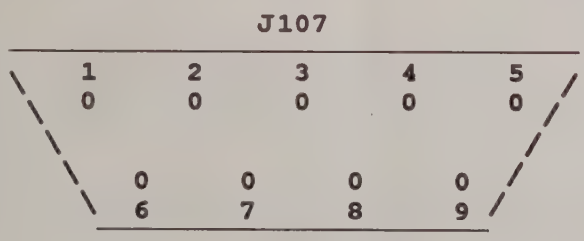
Programming can also be accomplished using a potentiometer connected between Pin 4 (+5Vdc) and Pin 7 (GND) with the wiper connected to Pin 6. The potentiometer should be a low temperature coefficient, wirewound or cermet type of 5kΩ to 20kΩ resistance value. The output will then be in proportion to the wiper position.

5.3 ANALOG MONITORING SIGNALS

Analog monitor signals of 0 to +5Vdc via 10 k-ohms are provided, which are linearly proportional to the unit's output voltage and current. A TTL-compatible logic TRIP input, a +5Vdc reference voltage output and an NPN open collector polarity indicator output are all available at J107.

FIGURE 5.1 below defines the pin locations and functions of the rear panel analog monitor and remote analog programming connector.

FIGURE 5.1



PIN	FUNCTION
1	Buffered output voltage monitor, 0 to +5Vdc via 10kΩ.
2	No connection.
3	TTL level compatible logic input. Input logic zero disables high voltage generation. Open circuit or input logic one enables high voltage generation.
4	Precision +5Vdc reference output, referenced to analog ground.
5	Buffered output current monitor, 0 to +5Vdc via 10kΩ.
6	Remote analog programming input, 0 to +5 volts.
7	Analog ground.
8	Digital ground.
9	NPN open collector with respect to digital ground, indicating output high voltage polarity. NPN saturation denotes positive polarity (logic 0), NPN cut-off denotes negative polarity (logic 1).

SECTION VI MAINTENANCE

6.1 GENERAL

The high voltage power supply should not require any maintenance or calibration. It is designed for reliable, trouble free operation. If any question should arise, contact the Bertan Customer Service Department for assistance or return authorization. Although adequate information is provided in the schematic provided with this manual, it is suggested that the unit be returned to the factory if service should become necessary.

SECTION VII APPENDIX

7.1 IBM PC/XT/AT (DOS 3.1 OR HIGHER REQUIRED)

1. Equip the computer with the IO Tech Personal 488A interface.
2. Install software driver per the Personal 488A instructions.
3. Set the address switches on the Model 225 to 7
4. Run the BASIC interpreter which comes with the computer.
5. Enter the lines of the program below using the "return" key after each line.
6. Press RUN key (F2) after the total program has been entered. Enter a command when prompted. For example, if you enter "P0.1000KG", wait approximately two seconds and then enter "T1", the resulting display is nominally "N V0.1000K".

```
PROGRAM                                          REMARKS
10 OPEN "\DEV\IEEEOUT" FOR OUTPUT AS #1          Set up output file
20 IOCTL#1,"BREAK"                               Clear buffers in
                                                 basic
30 PRINT#1,"RESET"                               Init the bus with
                                                 IFC
40 OPEN "\DEV\IEEEIN" FOR INPUT AS#2             Set up input file
                                                 to BASIC
50 PRINT#1,"REMOTE 07"                           Place the 225 in
                                                 remote
60 INPUT "COMMAND";A$
70 PRINT#1,"OUTPUT 07;";A$                       Address 225 to
                                                 listen and send the
                                                 send the string
80 INPUT "COMMAND",A$
90 PRINT#1,"OUTPUT 07;";A$
100 PRINT#1,"ENTER 07"                           Address 225 to talk
110 LINE INPUT#2,A$                              Input the bytes
120 PRINT A$                                     Display the reading
130 END
```

7.2 IBM PS/2 USING IO TECH INTERFACE (DOS 3.1 OR HIGHER REQUIRED)

1. Equip the computer with the IO Tech PS/2 488A interface.
2. Install the Software driver following the PS/2 488A manual instructions.
3. Set the address switches on the Model 225 to 7
4. Run the BASIC interpreter which comes with the computer.
5. Enter the lines of the program below using the "return" key after each line.
6. Press RUN key (F2) after the total program has been entered. Enter a command when prompted. For example, if you enter "P0.1000KG", wait approximately two seconds and then enter "T1", the display should nominally return "N V0.1000K".

```
PROGRAM                                          REMARKS
10 OPEN "\DEV\IEEEOUT" FOR OUTPUT AS #1          Set up output file
20 IOCTL#1,"BREAK"                               Clear buffers in basic
30 PRINT#1,"RESET"                               Init the bus with IFC
40 OPEN "\DEV\IEEEIN" FOR INPUT AS#2             Set up input file to
                                                 BASIC
50 PRINT#1,"REMOTE 07"                           Place the 225 in remote
60 INPUT "COMMAND";A$
```

```
 70 PRINT#1,"OUTPUT 07;";A$          Address 225 to listen
                                     and send the string
 80 PRINT#1,"ENTER 07"               Address 225 to talk
 90 INPUT "COMMAND";A$
100 PRINT#1,"OUTPUT 07;";A$
110 LINE INPUT#2,A$                  Input the bytes
120 PRINT A$                         Display the reading
130 END
```

7.3 HP 85/86/87

1. Equip the computer with an HP 82937 GPIB interface and an I/O ROM.
2. Set the address switches on the Model 225 to 7.
3. Enter the lines in the program below. Use the END LINE key after each line.
4. Press the RUN Key when the total program is entered. Enter a command when prompted to do so. For example, if you enter "P0.1000KG", wait approximately two seconds and then enter "T1", the CRT will nominally show the string "N V0.1000K".

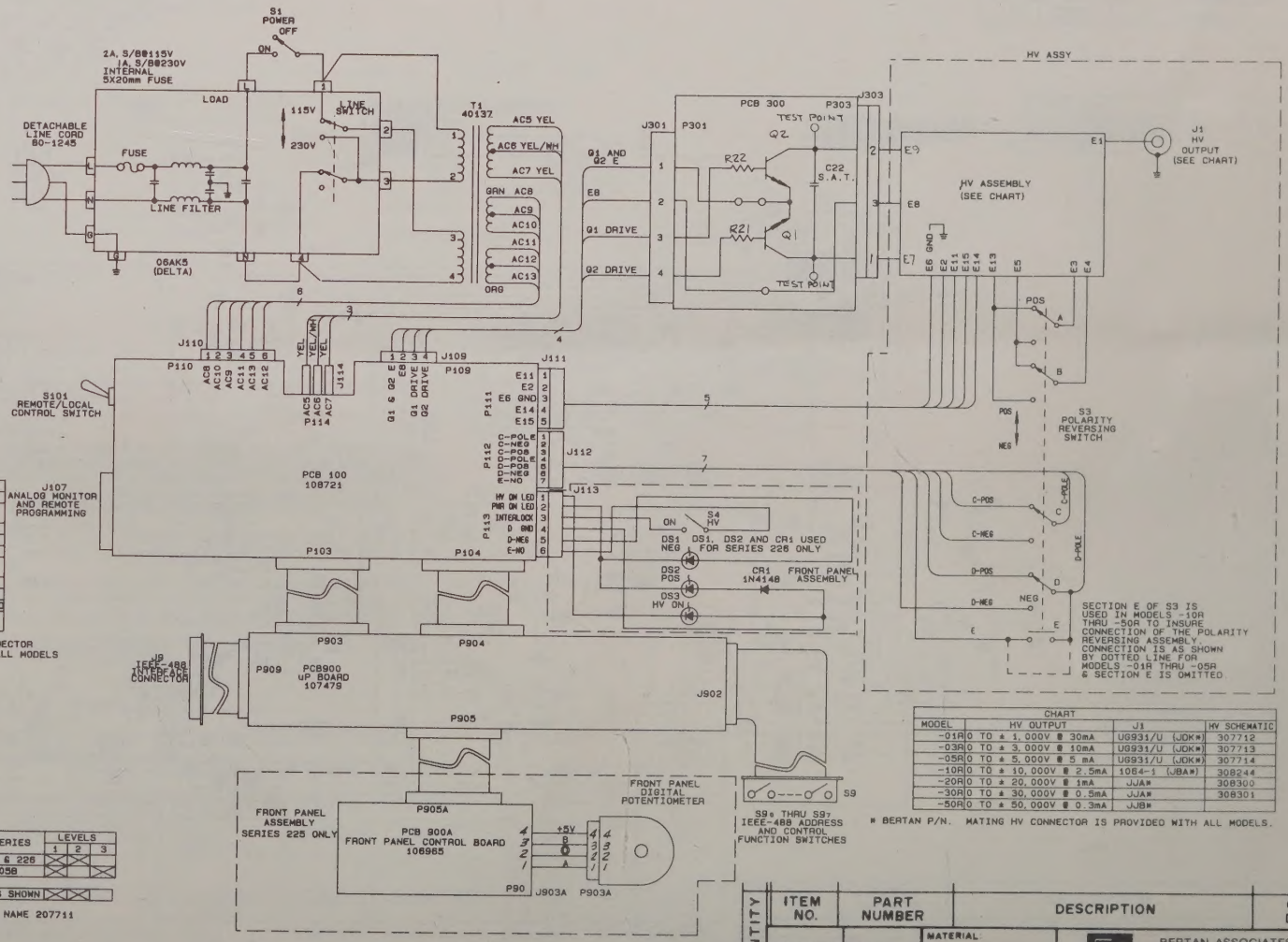
```
     PROGRAM                    REMARKS
 10  REMOTE 707                 Place 225 in remote.
 20  DISP "Command"             Prompt for command.
 30  INPUT A$
 40  OUTPUT 707;A$              Address 225 to listen, send string.
 50  DISP "Command"
 60  INPUT A$
 70  OUTPUT 707;A$
 80  ENTER 707;A$               Address 225 to talk, return reading.
 90  DISP A$                    Display ready on CRT.
100  END
```

7.4 HP 9825A

1. Equip the computer with the HP98034A GPIB interface and the extended I/O ROM.
2. Set the address switches on the Model 225 to 7.
3. Enter the lines in the program below using the "STORE" Key after each line.
4. Press the RUN Key when the total program is entered. Enter a command when prompted to do so. For example, if you enter "P0.1000KG", wait approximately two seconds and then enter "T1", the resulting display is nominally "N V0.1000K".

```
     PROGRAM                    REMARKS
 10  rem 707                    Place the 225 in remote.
 20  ent "COMMAND",A$           Prompt for command.
 30  wrt 707,A$                 Address 225 to listen, send command.
 40  ent "COMMAND",A$
 50  wrt "COMMAND",A$
 60  red 707,A$                 Address 225 to talk, input reading.
 70  prt A$                     Print reading.
```

LTR	REVISIONS		DATE	APPROVED
F	SEE ECN 6024		5/15/85	
G	SEE ECN 6586	FC	3/14/89	
H	SEE ECN 6786		6/26/89	
J	SEE ECN 6869		9/8/89	
K	SEE ECN 7186		11/16/90	



J107	
PIN	FUNCTION
1	KV MON
2	NC
3	TRIP
4	5V REF OUT
5	CURRENT MONITOR
6	KV SET
7	ANALOG GROUND
8	DIGITAL GROUND
9	POLARITY IND (NEG/POS)

J107 ANALOG MONITOR AND REMOTE PROGRAMMING

MATING ANALOG CONNECTOR IS PROVIDED WITH ALL MODELS

CHART			
MODEL	HV OUTPUT	J1	HV SCHEMATIC
-01R	0 TO ± 1,000V @ 30mA	UG931/U (JDK*)	307712
-03R	0 TO ± 3,000V @ 10mA	UG931/U (JDK*)	307713
-05R	0 TO ± 5,000V @ 5 mA	UG931/U (JDK*)	307714
-10R	0 TO ± 10,000V @ 2.5mA	1084-1 (JBA*)	308244
-20R	0 TO ± 20,000V @ 1mA	JJA*	308300
-30R	0 TO ± 30,000V @ 0.5mA	JJA*	308301
-50R	0 TO ± 50,000V @ 0.3mA	JJB*	

* BERTAN P/N. MATING HV CONNECTOR IS PROVIDED WITH ALL MODELS.

SERIES	LEVELS 1	2	3
225 & 226	X		X
2058	X	X	X

LEVELS SHOWN X X X

FILE NAME 207711

QUANTITY	ITEM NO.	PART NUMBER	DESCRIPTION	COMP DESIG
108241		226		
108241		225		
NEXT ASSY		USED ON		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS DECIMALS ANGLES

MATERIAL

FINISH

DR LE 5-10-88

CK

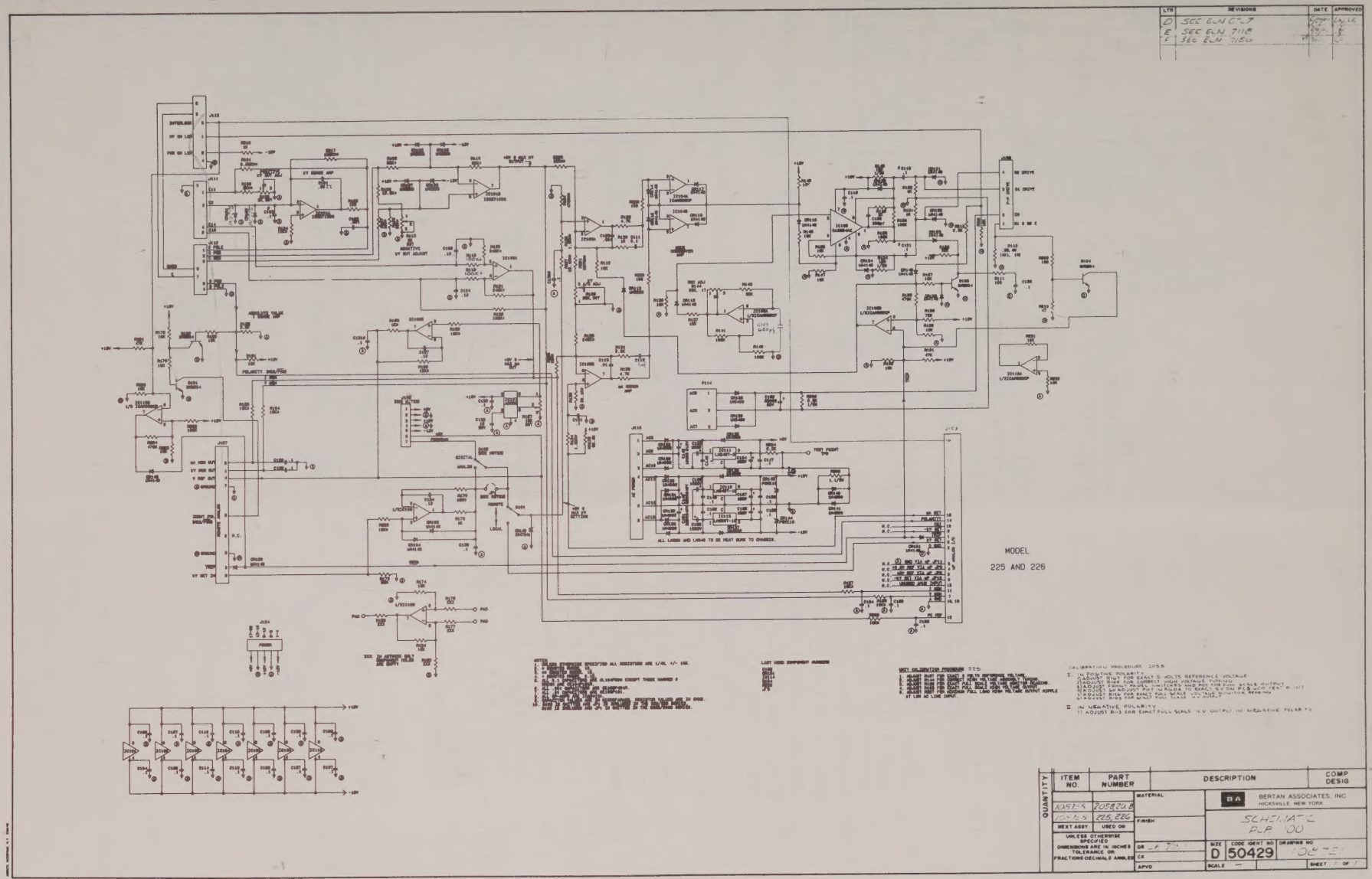
APVD WSB 5/12/88

BERTAN ASSOCIATES, INC
HICKSVILLE, NEW YORK

SCHEMATIC BLOCK DIAGRAM

SIZE C | CODE IDENT NO 50429 | DRAWING NO 207711

SCALE — | SHEET 1 OF 2



LTR	REVISIONS	DATE	APPROVED
D	SEE ECN C-7		
E	SEE ECN 7116		
F	SEE ECN 7150		

QUANTITY	ITEM NO.	PART NUMBER	DESCRIPTION	COMP DESIG
1057-9		205826 B		
1058-9		225, 226		
NEXT ASSY		USED ON		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS DECIMALS ANGLES

MATERIAL

FINISH

DR

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APVD

BA BERTAN ASSOCIATES, INC. HICKSVILLE, NEW YORK

SCHEMATIC P.P. 00

SIZE D | CODE IDENT NO 50429 | DRAWING NO

SCALE —

SHEET 1 OF 1

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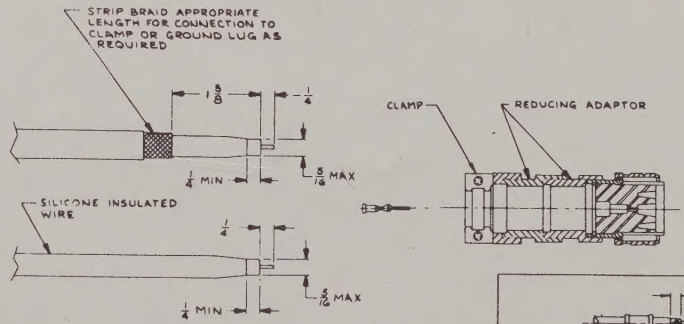

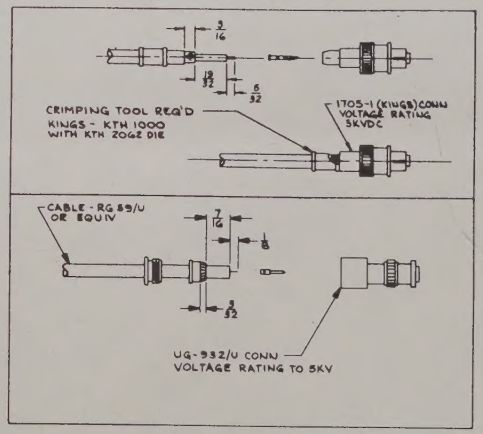

NOTES:
1. REMOVE BURRS AND SHARP CORNERS FROM ALL PARTS.
2. CLEAN WITH ACETONE AND ALLOW TO DRY COMPLETELY.
3. CUT, STRIP AND TIN CENTER CONDUCTORS OF CABLES. SOLDER CONDUCTORS TO CONTACTS. REMOVE FLUX RESIDUE WITH ACETONE.
4. CAREFULLY ALIGN THE KEY/KEYWAY OF THE RUBBER INSERT AND SHELL AND ASSEMBLE THE INSERT TO THE SHELL.
5. COAT OUTSIDE OF CONTACTS (FEMALE/MALE) WITH GENERAL ELECTRIC RTV 108 ADHESIVE. APPROXIMATE AREA OF CONTACT WHICH WILL TOUCH THE RUBBER INSERT.
6. INSERT CONTACTS (FEMALE/MALE) INTO THE RUBBER INSERT, MAKING SURE THAT THE RIDGE ON THE CONTACT PORS INTO THE GROOVE INSIDE OF THE INSERT.
7. CURE ADHESIVE AT ROOM TEMPERATURE FOR 24 HOURS.
8. ASSEMBLE THE REST OF THE CONNECTOR.
9. FOR MAXIMUM ELECTRICAL INSULATION, POT THE REST OF THE CONNECTOR WITH A SELF LEVELING SILICONE POTTING USING GENERAL ELECTRIC RTV 112 OR RTV 118.
10. CAREFULLY SQUEEZE RTV 118 FROM THE TUBE INTO THE REAR WELL OF THE CONNECTOR SHELL SO THAT APPROXIMATELY 1/4 OF THE DEPTH IS FILLED. DO NOT OVERFILL. CURE ADHESIVE AT 70°F AND 60% RELATIVE HUMIDITY FOR A MINIMUM OF 72 HOURS.
11. REPEAT STEP 10 UNTIL THE CONNECTOR WELL IS COMPLETELY FILLED.

BERTAN ACCESSORY KIT	BERTAN CONNECTOR	REDUCING ADAPTOR	CLAMP	CABLE				RATED OUTPUT
				MANUFACTURER	TYPE	MANUFACTURERS PART NUMBER	BERTAN PART NUMBER	
405787	PJA	AN3055-18-10	MS3057-10A	DIELECTRIC SCIENCE	SHIELDED	2012-SNJ	020	40KV
405787	PJA	AN3055-18-10	MS3057-10A	MARKEL INDUSTRIES	UNSHIELDED	3239	004	40KV
405786	PJB	AN3055-22-12	MS3057-12A	DIELECTRIC SCIENCE	SHIELDED	2024-SNJ	021	60KV
405786	PJB	AN3055-22-12	MS3057-12A	ROWE INDUSTRIES	UNSHIELDED	R790-G016	005	60KV

QUANTITY	ITEM NO.	PART NUMBER	DESCRIPTION	COMP DESIG

NEXT ASSY | USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS·DECIMALS ANGLES

MATERIAL:

FINISH:

DR GRYGO 4-21-86

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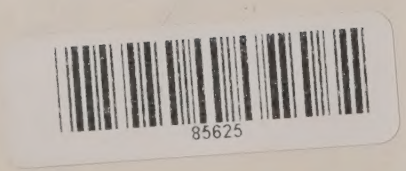
ASSEMBLY INSTRUCTIONS FOR BERTAN H.V. CONN.

SIZE C | CODE IDENT NO 50429 | DRAWING NO 201210

SCALE | SHEET 1 OF 1

ABRICO, HICKSVILLE, N.Y. 08416


85625